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HOSPITAL TECHNICAL MEMORANDUM

STAFF LOCATION SYSTEMS

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Staff Location Systems

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References

I. Introduction

1. Rapid location of medical, nursing and other key members of the staff in a hospital is often difficult to achieve by telephone as such staff may not follow a precisely timed schedule. In particular it may be necessary to contact members of the medical staff urgently, but apart from emergency situations, the rapid location of staff increases the general efficiency of a hospital, and a staff location system is regarded as a necessity in a modern hospital.

2. Most staff call systems operate in conjunction with the telephone system and provide a means of informing members of the staff that there is a message for them and the member called proceeds to the nearest telephone to receive the message. This arrangement is generally satisfactory.

3. Recent radio development will enable messages to be passed direct to the person concerned and equipment is also available which will enable the recipient of the message to talk back direct to the central station.

4. Generally, calls are made via the telephone operator who operates the staff location system from a call initiating unit placed near the telephone switchboard.

5. Arrangements are available, however, which enable calls to be originated directly by telephone. Another special emergency arrangement enables a group call to certain pre-determined receivers to be originated by pressing a push-button located, for example, in an intensive nursing area.

6. It is also possible to use staff location systems in conjunction with the patient/nurse system.

II. Scope

7. This Memorandum deals with call systems which can be used for the rapid location of individual members or groups of the hospital staff whose whereabouts at any particular time are not generally known and who cannot be contacted quickly by other means. It is primarily intended to assist those engaged in the design of electrical and communication services for new hospitals but may also be applicable where major extension or improvements to existing hospitals are planned.

III. Definitions and abbreviations

8. **L.F.** Frequencies between 30 kc/s and 300 kc/s also referred to as long wave (LW).

M.F. Frequencies between 300 kc/s and 3 Mc/s also referred to as medium wave (MW).

H.F. Frequencies between 3 Mc/s and 30 Mc/s.

V.H.F. Frequencies between 30 Mc/s and 300 Mc/s.

NOTE: The frequencies used for hospital staff location (27·12 Mc/s ± 0·6 per cent or 31·75 Mc/s ± 12·5 kc/s) are colloquially known as V.H.F. systems (in fact 27·12 Mc/s is within the H.F. band).

U.H.F. Frequencies between 300 Mc/s and 3000 Mc/s.

A.M. Amplitude modulation, where a steady frequency signal is modulated by varying the amplitude of the wave.

F.M. Frequency modulation, where the amplitude of a signal remains constant and modulation is obtained by varying the frequency.

Audio frequency A frequency within the range audible to the normal human ear, i.e. 50 c/s to 15 kc/s.

Voice frequency Any frequency within that part of the audio frequency range normally used for the transmission of speech of commercial quality, i.e. 330 to 3400 c/s.

IV. Basic requirements

9. The basic requirements for a staff location system are:

(a) It should be quiet in operation and not disturb patients or members of the staff not being called.

(b) Calls should be clear and unmistakeable to the person or persons being called, but should not require undue concentration or impede the user in the performance of his normal duties.

(c) There should be full reliable coverage throughout the hospital complex.

(d) The equipment should not cause interference to, or suffer interference from, other equipment used in the hospital or its environment.

V. Types of call systems

10. Call systems may be divided into four systems, namely visual, audio, magnetic loop and radio.

Visual systems

11. Visual systems consist of coloured lamps or illuminated numbers mounted at strategic positions in corridors, wards, staff rooms, etc. Combinations of these are allocated to members of the staff and calls are originated from a central position, usually in the telephone switchroom by switching on the relevant coloured lamps or numbers.

12. This system has obvious limitations in that the personnel in question are required to be constantly alert to the possibility of a call being made and the system is ineffective when the lights are not in view. To be effective it is usually necessary to install a large number of indicators and a considerable quantity of cable. For these reasons this method of staff location is not recommended for new installations.

Audio systems

13. These use a number of loud-speakers installed at suitable positions; calls for personnel being broadcast from the loud-speakers. This method is unsuitable for patient areas and in other areas frequent calls can be a nuisance.

14. In general this system is considered to be unsuitable for hospital use.

Magnetic loop systems

15. These consist of one or more loops of cables which are arranged to encompass the buildings to be covered and are wired back to a central transmitting and control station. When a signal current from a call initiating unit is passed through the loop, a magnetic field is produced within and around the loop.

16. Members of the staff carry small pocket receivers each of which is set to respond to a particular signal or combination of signals. A receiver in the area covered by the loop which is tuned to the transmitted signal will emit an intermittent or continuous high pitched tone or " bleep ". The person called uses the nearest telephone to ascertain from the central station the reason for the call. In addition to individual calls, group calling facilities can be used, should it be necessary to call a number of people simultaneously.

17. Magnetic loop systems are currently used in many hospitals but in future it is expected that they will be mainly confined to small premises (see para. 28).

Radio systems

18. Radio systems differ from magnetic loop systems in that higher frequencies are used and calling signals are radiated from a central transmitting aerial.

19. As with loop systems a call initiation unit is used to select the calling frequencies and to modulate the transmitter. Amplitude or frequency modulation can be used.

20. Pocket receivers used with radio systems are generally similar to those used with loop systems except that they are designed to receive the higher frequencies.

21. The main advantage of radio systems is that cable loops are not required and this is particularly significant on sites covering a large area containing several buildings.

Additional special facilities

22. Extra facilities which can be provided on radio and loop staff call systems are described below. The provision of these facilities will be justified in special circumstances.

Call initiation by telephone

23. Equipment is available to enable a call to a pocket receiver to be initiated direct from telephone extensions, e.g. by dialling a special call initiating code followed by the receiver code number. The called person goes to the nearest telephone, dials a known code (which can be that of his own receiver) and is automatically connected to the telephone extension from which the call was initiated.

24. It is important that lock-on type receivers (see para. 59) are used with this facility otherwise the paging system may be outside the control of the telephone operator for long periods.

Group calling

25. Selected groups of receivers can be called simultaneously if, for example, a medical team is wanted for an emergency. The group alarm is usually of a distinctive note and if used in conjunction with speech, all those called will receive the message transmitted.

Speech facilities

26. Speech facilities are not normally necessary as the internal telephone system can be used for communication once the person concerned has been made aware that he is required. In special instances, however, e.g. where hospitals have cardiac arrest teams it may be considered essential for messages to be passed direct to key medical personnel and in very special circumstances it may be considered necessary for these key persons to be able to reply direct by radio.

Use with nurse call system

27. Staff call systems can be arranged to operate in conjunction with the patient/nurse call system. With this facility a call from a patient would normally be accepted by the nurse on duty at the nursing station. Should the nursing station be unattended the call would be transferred automatically to the staff location system and the nurse would receive the call on a pocket receiver. This facility can be particularly useful at night where a nurse may be covering more than one nursing unit. Automatic alarms from patient monitoring devices can similarly be passed to the staff call system.

VI. Choice of systems

28. The choice between magnetic loop and radio systems for a particular hospital will depend mainly on the site conditions, particularly the area of coverage, number and size of the buildings and the method of construction.

29. Generally the cost of central transmitting equipment and receivers is less with magnetic loop systems but to this must be added the installation costs of the loop(s). As the area to be covered increases, this item assumes greater importance until a point is reached where a loop system will cost more than a radio system giving the same facilities.

30. While it can be clearly stated that a loop system will be cheapest for small installations and a radio system for large installations, it is not possible to indicate where the dividing line occurs as site factors have an important influence on costs. With installations within the middle range competitive tenders should be obtained for both systems before a decision is made. In reaching a decision, the possibility of extending the coverage should be taken into consideration since the cost of extensions are likely to be higher with loop systems.

31. The practical advantage of such additional facilities as outgoing speech, talk-back and group calling should be carefully considered in relation to the cost involved in providing them, before any decision is reached on the provision of these facilities. Generally these facilities will be justified only in exceptional cases.

VII. Permitted frequencies

32. The G.P.O. is responsible for allocating frequencies for radio transmissions in the United Kingdom and for type testing and approving transmitting and associated equipment. The purpose of this control is to minimise interference between users of radio equipment.

33. Hospitals within the health service are not required to obtain the normal transmitting licence but hospital authorities must use equipment of a currently approved type and obtain written approval from the G.P.O. before it is installed or operated.

34. Appendix I lists the frequencies that can be used for staff location systems in hospitals together with other details regarding power output, limitations of speech, etc.

VIII. Magnetic loop systems

35. A magnetic loop is, in effect, an aerial which is designed to produce a magnetic field which is varied or modulated to enable signals to be transmitted to small pocket receivers. A fairly uniform field strength will exist within the loop. Outside the loop the field strength reduces rapidly but is usually effective up to a distance of 20 ft. The actual route taken by the loop does not have to be symmetrical and in practice a course will be chosen to suit the arrangements in the building, but the " go " and " return " conductors to a distant building should be run as close together as is practicable.

36. The area which can be satisfactorily covered by a single loop will vary with the type of construction, as metalwork affects the performance of the system. A typical maximum length for an approximately rectangular loop using 7/·029 in. cable and dissipating 10 watts with a modulated carrier of 37 kc/s, is 600 yds. It is not possible to generalise too much because of the many factors involved, and it is important for satisfactory results, that the loop is not excessively long and that the transmitter output circuit is correctly matched to the loop impedance. The installation of loop wiring is dealt with in para. 77.

37. Where the area to be covered is too much for a single loop it will be necessary to provide one or more additional loops. The general arrangement is for the additional loops to be fed by boost amplifiers which are located to suit these loops and are connected to the main transmitter by tie-lines so that signals are transmitted from all loops simultaneously (see para. 48). Loops should operate as a modulated carrier within the frequency range 16 kc/s—150 kc/s (see Appendix I).

38. There is a restriction on the field strength with loop systems and this must not exceed 20 mV/metre at a distance of 100 yds. Within this limitation, speech can be transmitted from the central station, but for technical reasons, it is not practicable to use the loop as a receiving aerial for talk-back facilities from pocket transmitters. A loop system can, therefore, provide only one-way speech, but can be used with small portable transmitters when two-way speech is necessary (see para. 65).

39. Early loop installations used a different frequency for each receiver within the range 400 c/s to 15 kc/s. Such installations cover the biological frequency range and can cause serious interference to sensitive electromedical apparatus (see Hospital Technical Memorandum No. 14).

IX. Radio (free-radiating aerial) systems

40. Free-radiating radio systems will be used where a magnetic loop system is not practical or economic. The G.P.O. prefer these systems to operate in the 27·12 Mc/s band; however this frequency band is also used for medical diathermy and serious electrical interference can occur particularly with amplitude modulated systems, consequently the use of 31·75 Mc/s is permitted at hospitals where there is medical diathermy.

41. Speech is not normally permitted on these frequencies. A special exception is made in certain hospitals having cardiac arrest teams, etc., where it can be shown that speech is essential for occasional emergency messages of short duration. This concession is of a temporary nature until suitable U.H.F. equipment becomes available (see Appendix I). Hospitals with emergency speech equipment on 27·12 or 31·75 Mc/s would not, however, be expected to replace such systems immediately alternative equipment becomes available, but should have a planned programme of replacement over a reasonable period of time so that the exceptional arrangements are not prolonged indefinitely.

42. The U.H.F. frequency band allocated for staff call systems which can include speech transmissions from the central station is, 458·8–459·5 Mc/s. At present cheap and compact U.H.F. receivers are not available, but the G.P.O. have permitted some relaxation with the receiver specification to facilitate the manufacture of small pocket receivers for use in this band and development work is well advanced.

X. Component items

Call initiation units

43. Small desk mounted control units, having a set of keys or push buttons are normally used for the initiation of calls to individual receivers. Some have a separate push button or key for each receiver while others have two sets of keys, one for " tens " and one for " units " and interlocks are provided to ensure that " tens " keys are pressed before " unit " keys. Equipment can be added to enable calls to be initiated from any extension on an automatic telephone system. This eliminates the services of the telephone operator.

44. All types of control units contain means of generating a number of pulses at different frequencies either by oscillatory circuits, or in a few cases, by electromechanical means and these are used to modulate the transmitter on modulated carrier systems. Because of limitations in the band-width available and the need to make the most effective use of a given number of oscillatory circuits, it is usual to permutate the frequencies in pairs. This will allow more calling signals to be obtained from a given number of modulating frequencies.

45. The following features can be included:

(a) A call timing variation device to give two or more types of calls to any receiver and so enabling the degree of urgency of a call to be indicated.
(b) A call " send " button to provide manual control of the transmission of call after the appropriate keys have been pressed.
(c) A call " cancel " button to terminate calls before automatic cancelling device operates.
(d) Speech button to enable speech to be transmitted on systems where speech is used.
(e) Indicating lamps which are illuminated whilst the call signal is being transmitted.

Transmitters

46. Low-powered loop transmitters may be incorporated with the control units in a common cabinet but generally transmitters are separately housed and are located either in the main control room or at a position convenient to the aerial feeding point. Crystal controlled oscillators have a high degree of frequency stability and are normally used with modulated carrier types of transmitters such as are used in modern loop and radio systems.

47. The power output of the transmitter will depend on whether it is used with a loop system or free radiating aerial and also on the frequency of the carrier. The Appendix gives details of the maximum output permitted on the various systems.

48. Where additional loops are necessary they will be fed by booster amplifiers which are located to suit the loops and are connected to the main transmitter by co-axial cable or by telephone tie-lines. In this way a central control unit can be used for all transmissions. Boost amplifiers are an additional loading on the main transmitter and the output of the latter should be increased accordingly.

49. Where the distance between the various loops is considerable, a ring main of co-axial cable could feed a number of booster amplifiers and in these instances it is necessary to use special tee-off networks at each amplifier to maintain the correct characteristic impedance of the ring.

50. Another alternative is for a booster amplifier supplying an auxilliary loop, to be connected to the primary loop which is fed by the main transmitter.

51. It is usual to control the power supply to boost amplifiers remotely from the main transmitter by arranging for the H.T. supply to be switched " on " only when the main transmitter is generating its carrier wave.

Satellite transmitters for radio systems

52. The effective range of a transmitter and aerial can be reduced by the presence of metallic structures and other obstructions which may cause radio waves to be attenuated and give rise to " dead areas " where reception will be unsatisfactory. In these instances it will be necessary to use satellite transmitters and aerials. Usually it is possible to connect satellite transmitters by co-axial cable so that the same signal is transmitted by the main and satellite aerials.

Fixed receivers

53. Fixed receivers for the reception of talk-back from pocket transmitters will operate on a frequency within the band 160·975–161·125 Mc/s.

54. Because of the low output of pocket transmitters it is necessary for these receivers to have a high sensitivity and to be specially designed for the frequency range in use. Receivers must comply with the relevant G.P.O. specification for this type of equipment.

55. In larger hospitals it is possible that more than one receiver will be required to obtain the necessary coverage. Each receiver should incorporate a means of selection to ensure that only the strongest of the received signals is passed to line.

Pocket receivers

56. The size, design and performance of pocket receivers differ between the various manufacturers, the transmission system used and the facilities offered. Some features which are applicable to loop and radio systems are discussed in the following paragraphs.

Size/weight

57. Invariably, receivers are transistorised to reduce size and weight. Typical size range is between 6 in. × 1 in. × $\frac{5}{8}$ in. and 5 in. × 2 in. × 1 in. and the weight range is between $3\frac{1}{2}$ and 8 ozs.

Robustness

58. Pocket receivers are particularly vulnerable to ill-treatment, such as dropping and it is important that they are as robust as possible. Apart from components being constructed to withstand shock it is necessary that the cases are tough. Improved shock-resistant plastics are now available while some receivers have a plastic-covered metal case for increased strength. Means of clipping receivers to a pocket are usually provided to assist in keeping the receiver vertical and to reduce the possibility of receivers being dropped.

Signalling methods

59. The majority of receivers incorporate a miniature loudspeaker for generating a continuous or pulsed high pitched calling tone. Sometimes the tone lasts for as long as the signal is being transmitted. Alternatively, a " lock-on " system is used where the receiver responds immediately to the transmitted signal and a driving circuit is switched " on " causing a continuous note to be produced until the circuit is broken by pressing a cancelling button on the receiver. This system will enable more calls to be made in a given period as the transmitter is only in operation for approximately one second per call and is an advantage for larger installations.

60. Some manufacturers provide volume controls on the receivers, whilst others offer a choice of normal or loud volumes. Receivers are also available with two or more different tones to indicate the degree of urgency. Small lamps are sometimes also provided on the top of the receiver as an alternative to, or in addition to the speaker so that the attention of the person carrying the receiver can be attracted in very noisy or very quiet locations. In the latter case the speaker would not be used.

Selectivity

61. It is necessary for receivers to be sufficiently selective to respond only to the signals intended for them and not to respond to calls that are intended for receivers on adjacent frequencies. The higher the degree of selectivity the greater the number of receivers that can be used within the available frequency band; but even so there is a limit to the number of separate receivers that can be called where single frequency signals are used. To increase the number, receivers can be arranged to respond to two signals pulses transmitted at different frequencies and in a particular sequence. This is known as a two-gate system, the first " gate " is opened by one signal and is held open long enough for the second " gate " to be opened by the following signal. Both gates must be opened for the receiver to accept the call. The receiver will only respond if the signals are transmitted in the correct sequence or in some instances simultaneously.

62. Because of the growing demand for radio staff location systems, there is an increasing possibility of interference between closely located installations. As a means of reducing interference the G.P.O. is to divide the 27 Mc/s band into 12 separate channels and to introduce a specification for pocket-type receivers which will require a degree of selectivity that will ensure that a receiver will only respond to signals on its own channel. The 27 Mc/s band channels are given in Appendix II.

Power supply

63. Pocket receivers are powered by either disposable primary cells of the mercury or carbon-zinc type, or with small re-chargeable alkaline batteries. Primary cells have a relatively long life, e.g. up to 4,000 hours for the mercury type and up to 400 hours for the carbon-zinc type. The re-chargeable batteries are usually put on charge each day by placing the receiver in a special charging rack (see paragraph 74). It is not necessary to remove the battery for re-charging, as the receivers are so arranged that the terminals connect with the charging supply whilst they are in the rack.

Circuitry

64. Circuit design depends mainly on whether the system is loop or radio but also varies between different manufacturers. Printed circuits are generally considered to be more robust and are extensively used.

Pocket transmitters

65. Pocket transmitters for use with two-way speech facilities operate on a frequency assigned by the G.P.O. in the 161 Mc/s band. They must, of necessity, be small and light-weight and consequently have a low power output but this is offset by the use of sensitive fixed receivers. The transmitters can be arranged to clip on to a similarly shaped receiver to make a combined unit, or carried separately. The aerial usually consists of a short length of flexible wire which can be easily tucked into the pocket with the transmitter/receiver when it is not in use.

66. Pocket transmitters are usually fully transistorised and have crystal controlled oscillators. The power supply consists either of a small re-chargeable battery or an expendable type of battery. Power requirements are small as the battery is used only during actual transmission, e.g. while a spring-loaded push-button is depressed.

67. Transmitters should be capable of being satisfactorily operated in any part of the premises covered by the calling system and to achieve this, it may be necessary to use more than one receiver aerial (see para. 73).

Aerials for radio systems

68. A transmitting aerial will be required for radio systems and separate receiving aerials will be necessary where " talk-back " facilities are provided. The aerials for transmission and reception will be similar in construction; usually half-wave dipoles made of aluminium tubing.

69. The overall length of the aerial will depend on the carrier frequency and will vary from approximately 5 metres for 27 Mc/s to 0·33 metres for 458 Mc/s, i.e. overall length is approximately half a wavelength.

70. Where the required coverage is within a single building the aerial may be mounted indoors, but generally better results will be obtained with an aerial mounted in a high central position outdoors. Obstruction close to the aerial should be avoided as transmission or reception coverage may be impaired.

71. Generally, vertically polarised transmissions will be used which will require the aerial to be vertical.

72. Where satellite aerials are necessary (see paragraph 52) these will be similar to the main aerial and should also be installed in a high central position within the area to be covered. Care should be taken to limit the signal radiated to within the site area.

73. With talk-back systems, because of the limited range of portable transmitters it is possible that two or more reception aerials with local amplifiers will be required.

Charging racks

74. Charging facilities are required for receivers having re-chargeable batteries and usually take the form of wall-mounted racks with rows of numbered slots into which the receivers are placed. Each charging position has two contacts which engage with mating contacts in the receiver thereby connecting the charging supply whilst the receiver is in the rack.

75. If the racks are positioned at the main entrance of the building or other convenient positions and each receiver is allocated exclusively to one member of the staff, the rack can be used to indicate whether the staff concerned are " in " or " out ". Racks can also be provided without charging facilities.

76. Other remotely located presence boards, consisting of a number of indicator lamps with appropriate staff names, can be operated from the main charging rack. In this way information on staff presence can be given at one or more locations, e.g., telephone switch-room, superintendent's office, etc.

XI. Installations

Loop wiring

77. 7/·029 in. single core P.V.C. insulated wiring is suitable and can be installed internally or externally. It is usually convenient to use service voids, false ceilings, etc., where these exist. Where it is necessary to conceal the wiring in floors, walls or ceilings, the use of plastic conduit is recommended.

78. To prevent screening of the magnetic field metal conduit trunking should not be used. Close proximity to large steel structural members particularly over long runs, will provide a considerable reduction in the magnetic field and where it is necessary to run loop wiring in parallel with steel beams of roof trusses, etc., the cable should preferably be positioned at least 12 in. away. The underside of window sills is a suitable location for external loop wiring, provided sills are not constructed of metal.

79. Wiring between buildings, e.g. to inter-connect loops or loop wiring which is intended to give calling facilities in the open, can be buried in the ground, e.g. at a depth of 12 in., or run in ducting at least 4 in. from other pipework. Alternatively, it can be supported above ground on a catenary wire.

80. Some typical loop arrangements are shown in Fig. I, but in practice the actual loop formation will depend on local arrangements. In some instances a single loop can cover several floors of a multi-storey building but if the construction includes much steelwork, it may be necessary to use separate loops for each one or two floors.

Wiring for radio systems

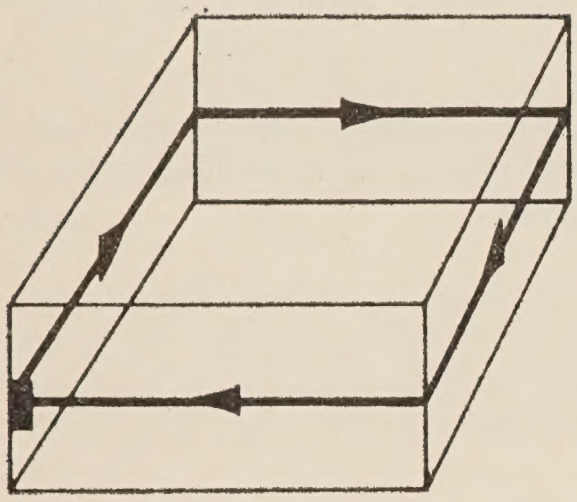
81. With radio systems the main connections between transmitters and aerials and between receivers and aerials should consist of co-axial cable to provide effective screening from nearby unscreened communication wires, etc, but the cable should be located well away from electricity mains cable.

82. Wiring runs should follow ducts, voids, walkways, etc., where practicable. Runs to and from ducts, etc., should be installed in conduit or steel trunking in those parts of the hospital where wiring is usually concealed, i.e. in public areas. In other areas signal wiring can be installed without further protection except where there is a possibility of mechanical damage, e.g. within 6 ft. of floor level.

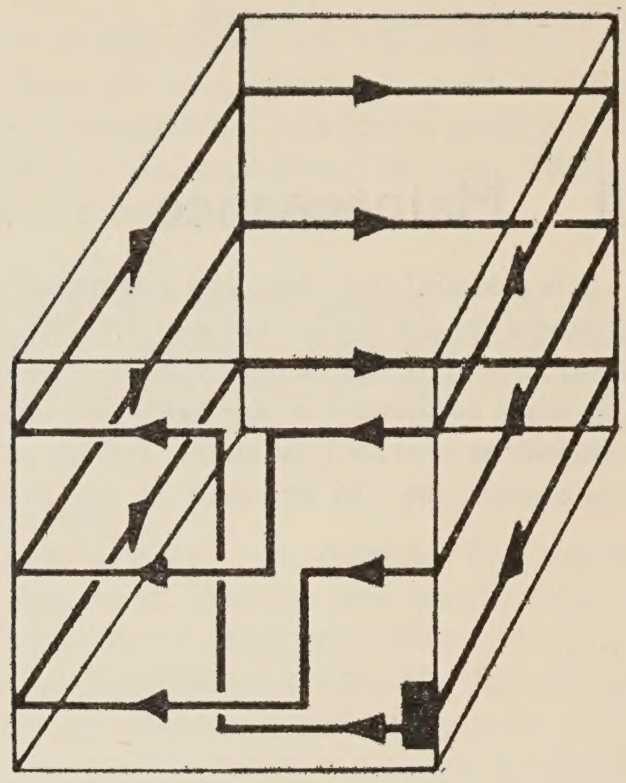
XII. Maintenance

83. It is essential that there is a planned maintenance programme for the equipment (see Hospital Technical Memorandum No. 13). Consideration should be given to this when equipment is purchased and testing facilities should be provided, to enable voltage and current measurements, etc., to be made at key points in the circuit without unduly disturbing the equipment.

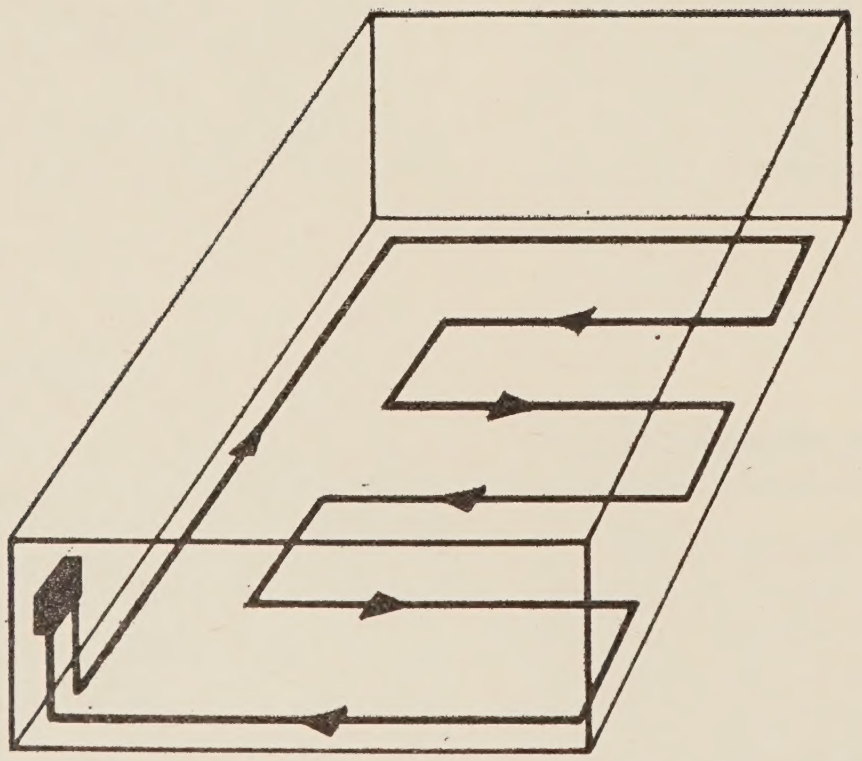
84. Because of the possibility of pocket receivers being damaged, inconvenience can be avoided by holding a few spare receivers.



LOW BUILDING WITH
ONE LOOP



MULTI-STOREY BUILDING
WITH CONTINUOUS CABLE
FORMING THREE LOOPS



LARGE AREA BUILDING WITH
CONTINUOUS CABLE ARRANGED
TO GIVE FULL COVERAGE

Figure 1. Typical Loop Arrangements

Appendix I

Frequencies used for staff location systems

Frequency band	*Maximum power*	*System and normal use*	*Speech allowed*	*Remarks*
16 to 150 kc/s, omitting 43 to 53 and 96 to 114 kc/s.	Field strength not to exceed 20 mV/m at 100 yd. from any part of the loop. Loop current not to exceed 2 amps.	Inductive loop system. Paging from central station to pocket receiver.	One-way speech from central station to pocket receiver.	
27·12 Mc/s ±0·6%.	10 W d.c. into final stage.	Free radiating aerial system. Paging from central station to pocket receivers.	One-way speech from central station to pocket receivers is allowed for occasional emergency use in hospitals with intensive care units etc.	This is an I.S.M. band which is in general use for medical diathermy. The concession allowing emergency speech is temporary, pending availability of suitable U.H.F. equipment.
31·75 Mc/s ±12 kc/s	10 W d.c. into final stage.	Free radiating aerial system. Paging from central station to pocket receivers.	One-way speech from central station to pocket receivers is allowed for occasional emergency use in hospitals with intensive care units, etc.	Use of this frequency is permitted where the use of 27·12 Mc/s is impracticable due to interference from medical diathermy operating on the same frequency. Same comments regarding emergency speech as for 27·12 Mc/s.
160·975 to 161·125 Mc/s	0·25 W.	Free radiating aerial system. For communication from pocket transmitter to central receiver.	One-way speech from pocket transmitter to central station.	This frequency is used for talk-back on two-way speech systems.

Appendix II

Channels for staff location systems within the 27·12 Mc/s (I.S.M.) band

1. 26·978 Mc/s
2. 27·003 Mc/s
3. 27·028 Mc/s
4. 27·053 Mc/s
5. 27·078 Mc/s
6. 27·103 Mc/s
7. 27·137 Mc/s
8. 27·162 Mc/s
9. 27·187 Mc/s
10. 27·212 Mc/s
11. 27·237 Mc/s
12. 27·262 Mc/s

References

BRITISH STANDARDS INSTITUTION

BS 415	Safety Requirements for Radio or other Electronic Apparatus for Acoustical or Visual Reproduction (electric mains supplied).
CP 321	Electrical Installations—General.
CP 327·402	Staff Location Systems.

INSTITUTION OF ELECTRICAL ENGINEERS

Wiring Regulations for the Electrical Equipment of Buildings.

H.M.S.O.

Hospital Technical Memorandum No. 14—Abatement of Electrical Interference.

Ministry of Health:

Hospital Technical Memoranda

The following titles in this series have been issued:

1.	Anti-static precautions: rubber, plastics and fabrics	1s 0d (1s 3d)
2.	Anti-static precautions: flooring in anaesthetising areas	1s 3d (1s 8d)
3.	Fire precautions: fish fryers	1s 0d (1s 3d)
4.	Colour code of flexible cables and cords	6d (9d)
5.	Steam boiler plant instrumentation	1s 6d (1s 9d)
6.	Protection of condensate systems: filming amines	6d (9d)
7.	Electrical services—supply and distribution	7s 6d (8s 1d)
8.	Safety code for electro-medical apparatus	3s 6d (3s 11d)
9.	Pneumatic tube communications systems	1s 6d (1s 11d)
10.	Pressure steam sterilisers	3s 0d (3s 5d)
11.	Emergency electrical services	5s 0d (5s 6d)
12.	Maintenance of buildings, plant, and equipment	3s 0d (3s 5d)
13.	Planned preventive maintenance: a system for engineering plant and services	6s 0d (6s 7d)
14.	Abatement of electrical interference	4s 0d (4s 5d)
15.	Patient/Nurse call systems	4s 6d (5s 0d)
16.	Fire precautions	4s 6d (5s 0d)
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